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EXPANSIBLE SHALE*

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The manufacture of lightweight concrete aggregate from common shale is one of the most rapidly growing industries in California today. The first plant in the state was established near San Rafael in 1932. The industry throughout the nation experienced only minor growth from its beginning until the end of World War II but the acceleration of residential and industrial building from 1945 until the present has stimulated a six-fold increase in the number of plants operating in this country. In 1959, five plants in California were producing expanded shale and a sixth was producing a burned diatomite for use in concrete products. The value of the lightweight aggregate produced in 1959 exceeded 1.5 million dollars.

GEOLOGY

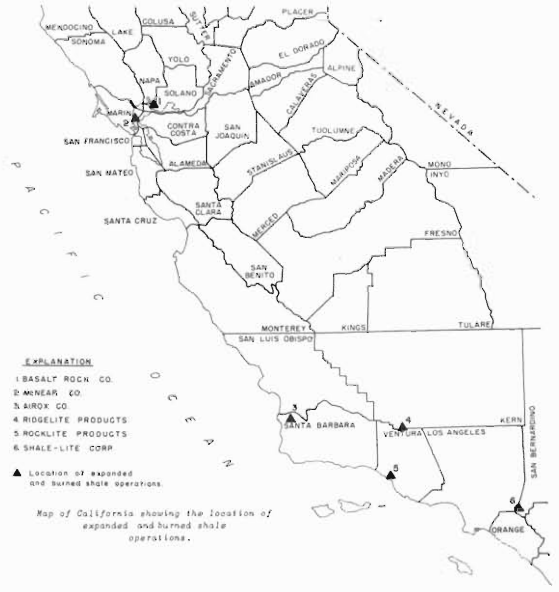
Shale is commonly defined as a moderately indurated, laminated or fissile sedimentary rock composed primarily of mineral particles in the size range of clay or silt. When used with reference to raw material for the production of lightweight aggregate, however, the phrase "expansible shale" ordinarily includes virtually any fine-grained sedimentary or metasedimentary rock that expands when heated under suitable conditions. Classed as expansible shale in an industrial sense, therefore, is common shale, massive material such as claystone and the metamorphic rock slate. In the discussion to follow, the term "shale" will refer to the general group of fine-grained, clay-rich sedimentary and metasedimentary rocks.

A typical expansible shale is a fine-grained argillaceous rock of marine origin. The minerals usually found in shale include clay, chlorite, quartz, feldspar, and mica with minor amounts of organic carbon, pyrite, calcite, and gypsum.

Reconnaissance sampling and testing of shale deposits by the California Division of Mines indicates that deposits of expansible shale potentially suitable for industrial use occur primarily in marine sedimentary formations of Jurassic, Cretaceous, Eocene, and Pliocene ages. Some shale of Miocene age is suitable, but the Miocene shale of the Monterey formation ordinarily contains too much silica to permit a suitable expansion. The Quaternary sedimentary units of California generally consist of coarser non-expansible detritus.

In northern California, formations of Jurassic and Cretaceous age contain shale of potential commercial interest. The shale is especially abundant in the Knoxville formation of Upper Jurassic age and the Horsetown formation of Lower Cretaceous age, which are exposed in a north-trending belt about 150 miles long and as much as 20 miles wide. This belt extends from Redding to Fairfield along the west side of the Sacramento Valley. The shale-bearing units are thousands of feet thick, and mineable bodies many hundreds of feet thick and thousands of feet in exposed length occur in the area between Paskenta and Wilbur Springs and in the area northeast of Napa.

Shale of Lower Cretaceous age also is abundant along the south and east flanks of Mount Diablo, Contra Costa County, and bodies hundreds of feet thick are common in the area south of Clayton. In the Diablo Range, along the east side of the Santa Clara Valley, shale-bearing units of Upper Jurassic to Lower Cretaceous age form belts as much as 4 miles wide and 10 miles long. Although the shale is interlayered with sandstone, mineable shale bodies are as much as 1,000 feet thick and half a mile in exposed length. In the San Jose region of Santa Clara County, shale interbedded with sandstone occurs in the Knoxville formation of Upper Jurassic age and Berryessa forma-



Map of California showing the location of expanded and burned shale operations.

*Based in part upon a chapter by B.H. Rogers and Charles W. Chesterman in California Division of Mines Bulletin 176.